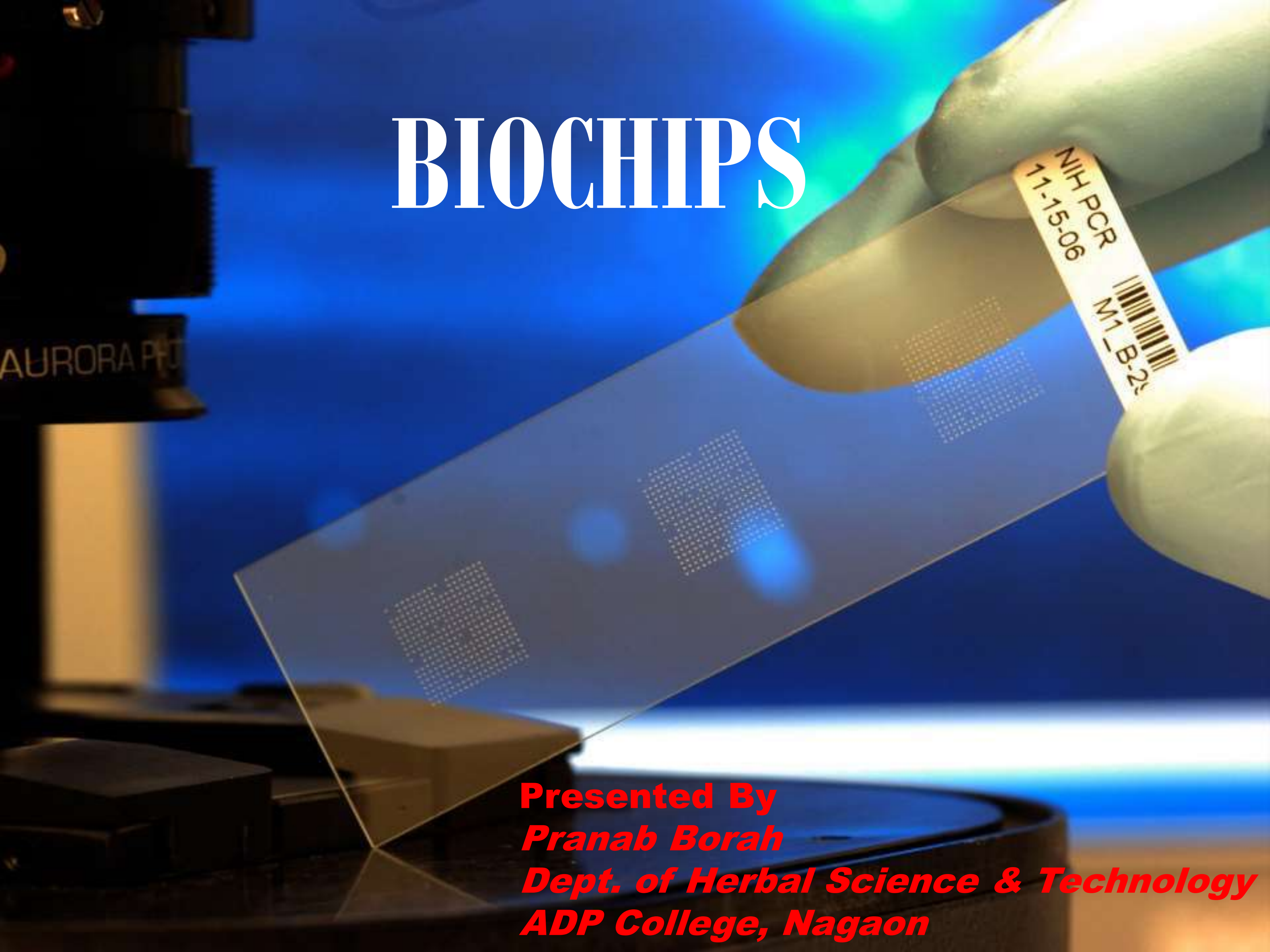

BIOCHIPS

Presented By
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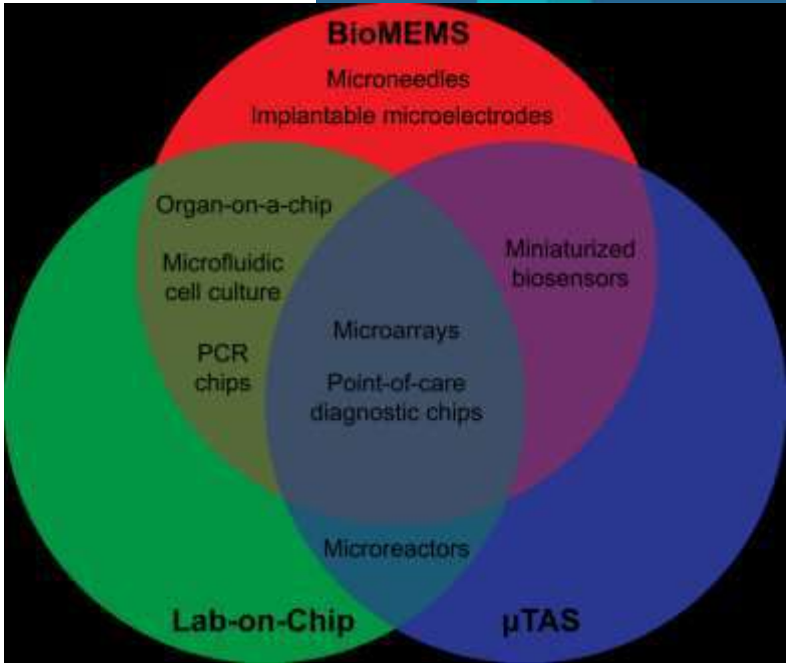
Dept. of Herbal Science & Technology
ADP College, Nagaon

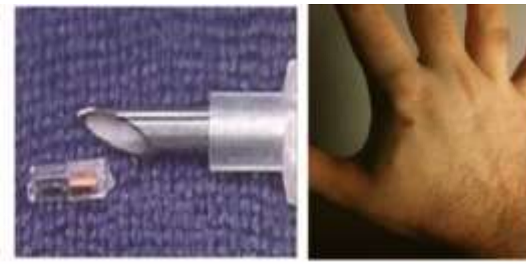
What is Biochips ???

A biochip is a collection of miniaturized test sites (micro arrays) arranged on a solid substrate that permits many tests to be performed at the same time in order to get higher throughput and speed. Typically, a biochip's surface area is not longer than a fingernail. Like a computer chip that can perform millions of mathematical operation in one second, a biochip can perform thousands of **biological operations,** such as decoding genes, in a few seconds.

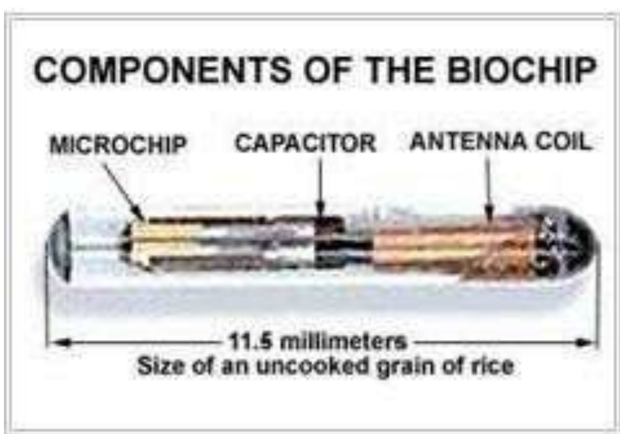


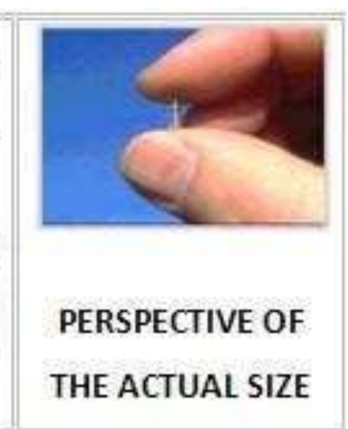
STRUCTURE AND WORKING OF AN ALREADY IMPLANTED SYSTEM

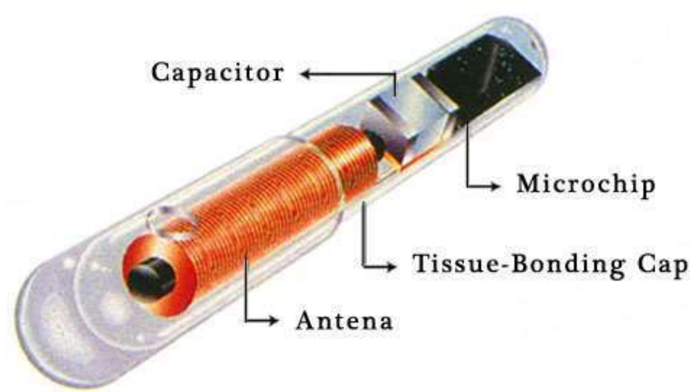
The biochip implants system consists of two components: **a transponder and a reader or scanner.** The transponder is the actual biochip implant. The biochip system is radio frequency identification **(RFID)** system, using low-frequency radio signals to communicate between the biochip and reader. The reading range or activation range, between reader and biochip is small, normally between 2 and 12 cm.



Hypodermic syringe (Biochip implement)







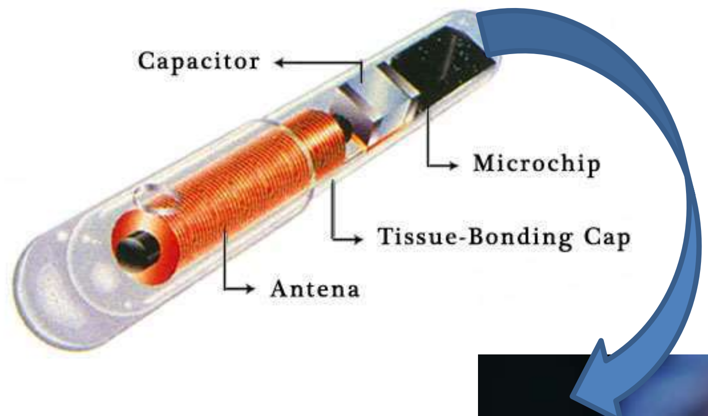
The Transponder

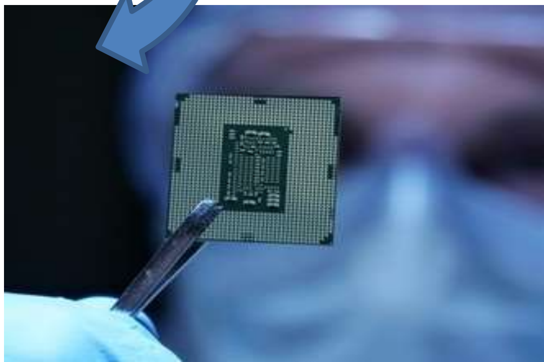
The transponder is the actual biochip implant. It is a **passive** transponder, meaning it contains no battery or energy of its own. In comparison, an active transponder would provide its own energy source, normally a small battery.

The biochip-transponder consists of four parts; **computer microchip, antenna coil, capacitor and the glass capsule.**

Computer Microchips

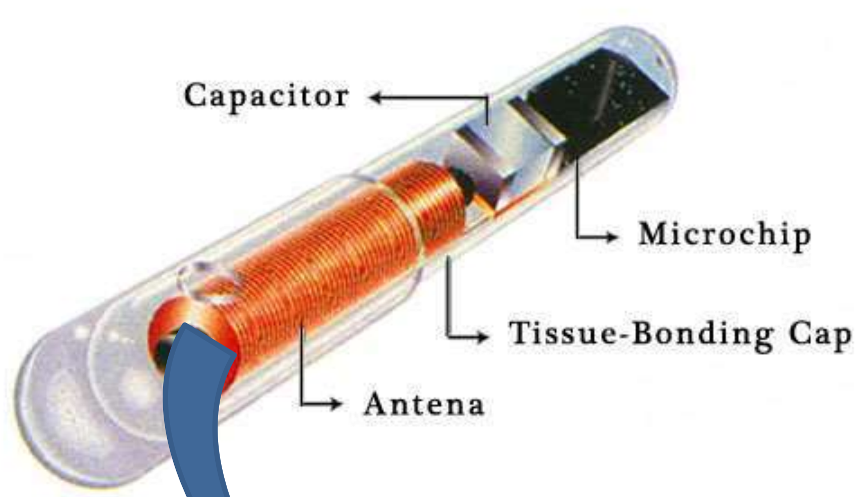
The microchip stores a unique identification number from 10 to 15 digits long. The storage capacity of the current microchips is limited, capable of storing only a single ID number





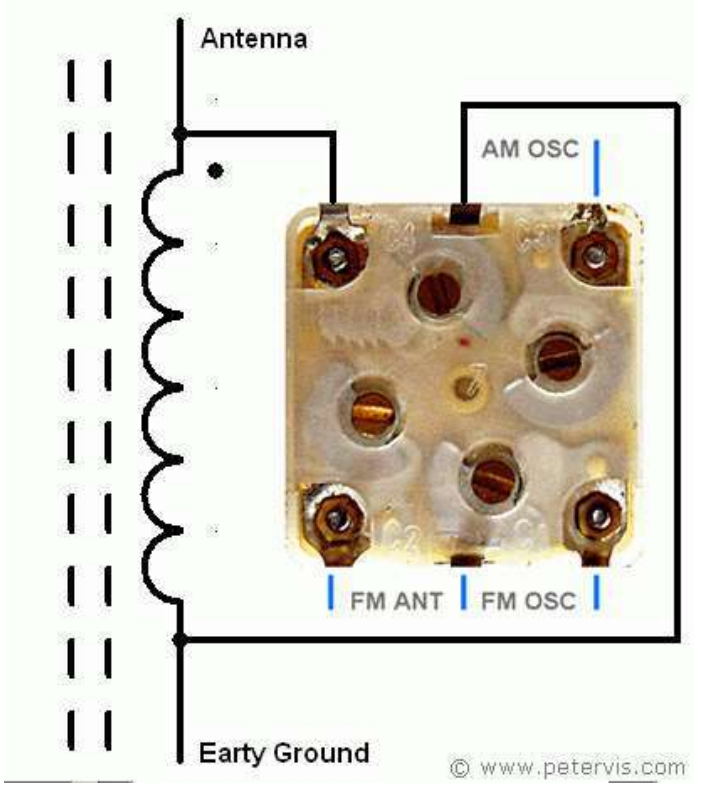
Antenna Coil

This is normally a simple, coil of copper wire around a ferrite or iron core. This tiny, primitive, radio antenna receives and sends signals from the reader or scanner.



Tuning Capacitor

The capacitor stores the small electrical charge (less than 1/1000 of a watt) sent by the reader or scanner, which activates the transponder. This “activation” allows the transponder to send back the ID number encoded in the computer chip. Because “radio waves” are utilized to communicate between the transponder and reader, the capacitor is tuned to the same frequency as the reader.

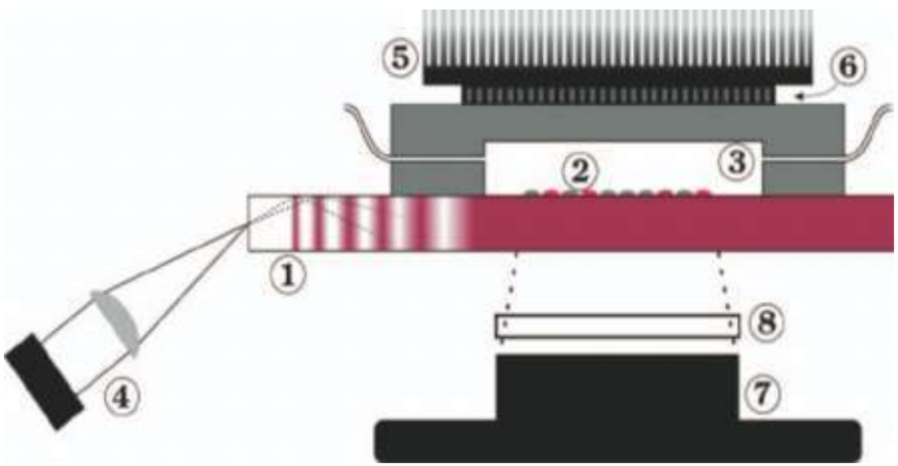


Glass Capsule

The glass capsule “houses” the microchip, antenna coil and capacitor. It is a small capsule, the smallest measuring 11 mm in length and 2 mm in diameter, about the size of an uncooked grain of rice. The capsule is made of **biocompatible material** such as soda lime glass.

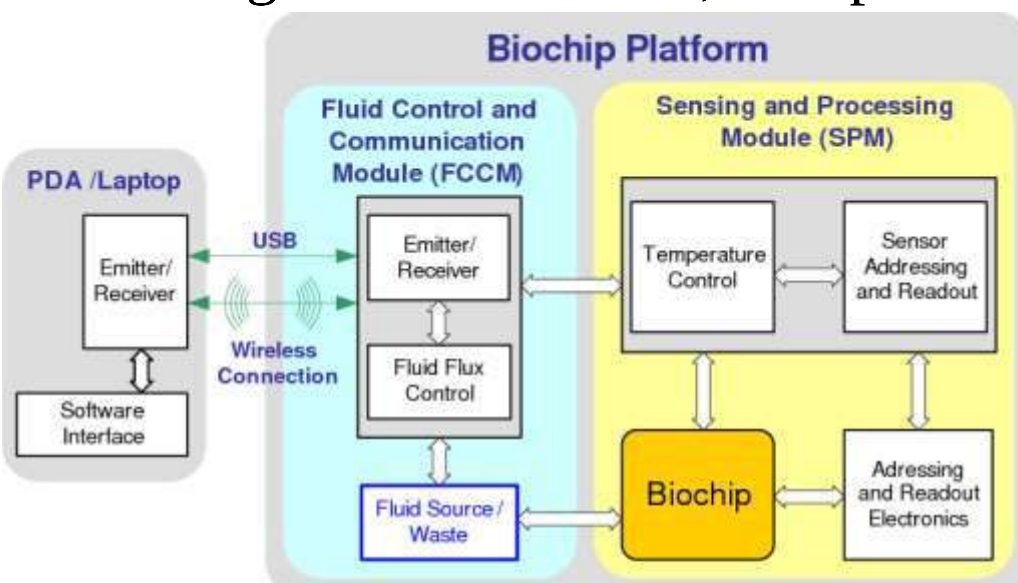
The Reader:

The reader consists of an “**exciter coil”** which creates an electromagnetic field that, via radio signals, provides the necessary energy (less than 1/1000 of a watt) to “**excite” or “activate”** the implanted biochip. The reader also carries a receiving coil that receives the transmitted code or ID number sent back from the “activated” implanted biochip. This all takes place very fast, in milliseconds. The reader also contains the software and components to decode the received code and display the result in an LCD display. The reader can include a RS-232 port to attach a computer.



Working Principle of Biochips:

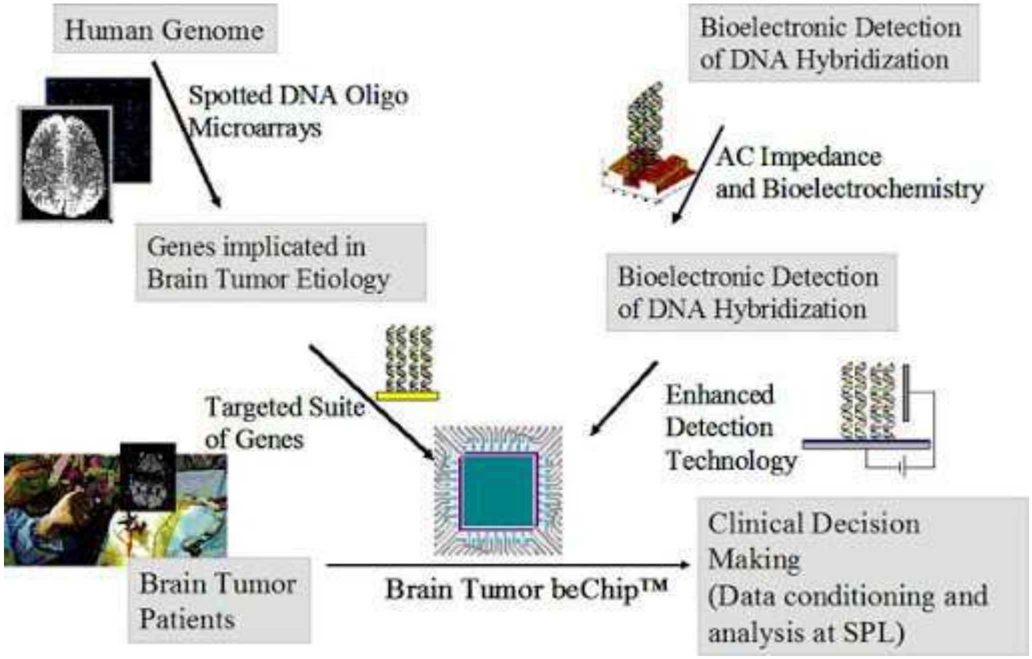
The reader generates a low-power, electromagnetic field, in this case via radio signals, which "activates" the implanted biochip. This "activation" enables the biochip to send the ID code back to the reader via radio signals. The reader amplifies the received code, converts it to digital format, decodes and displays the ID number on the reader's LCD display. The reader must normally be between 2 and 12 cm near the biochip to communicate. The reader and biochip can communicate through most materials, except metal.



APPLICATIONS OF BIOCHIP

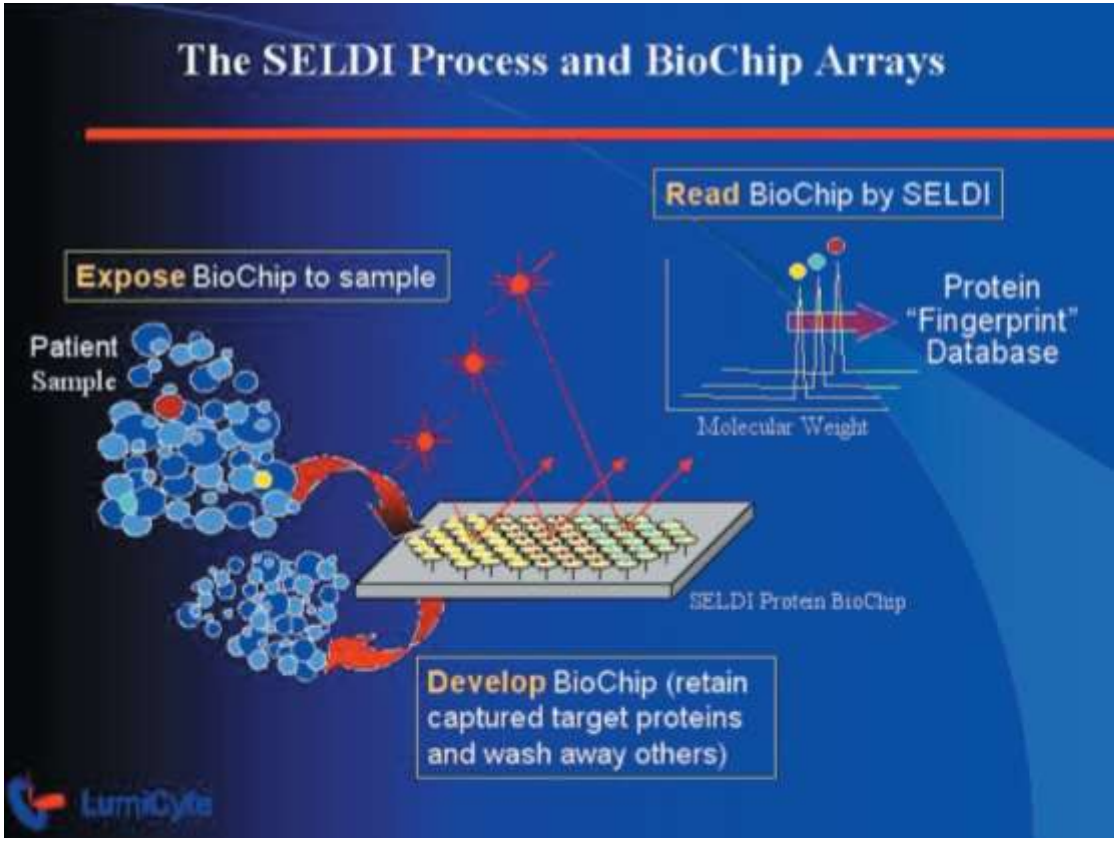
Genomics

Genomics is the study of gene sequences in living organisms and being able to read and interpret them. The human genome has been the biggest project undertaken to date but there are many research projects around the world trying to map the gene sequences of other organisms. The use of Biochip facilitate: Automated genomic analysis including genotyping, gene expression DNA isolation from complex matrices with aim to increase recovery efficiency DNA amplification by optimizing the copy number DNA hybridization assays to improve speed and stringency .



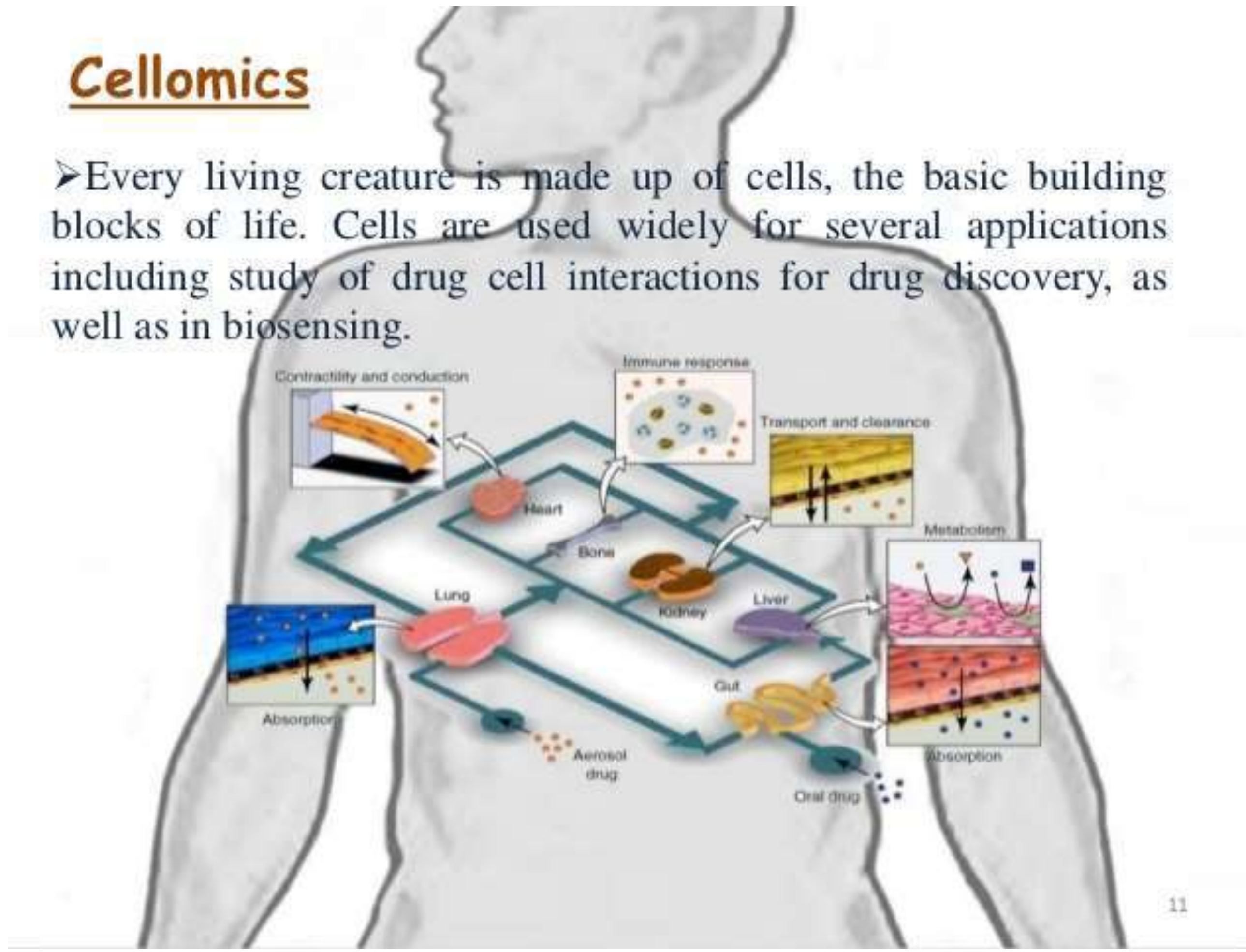
Proteomics

Proteome analysis or Proteomics is the investigation of all the proteins present in a cell, tissue or organism. Proteins, which are responsible for all biochemical work within a cell, are often the targets for development of new drugs



Cellomics

Every living creature is made up of cells, the basic building blocks of life.. Cells are used widely by for several applications including study of drug cell interactions for drug discovery, as well as in biosensing.



The use of Biochip in cellomics facilitates:

- Design/develop "lab-in-cell" platforms handling single or few cells with nanoprobes in carefully controlled environments.

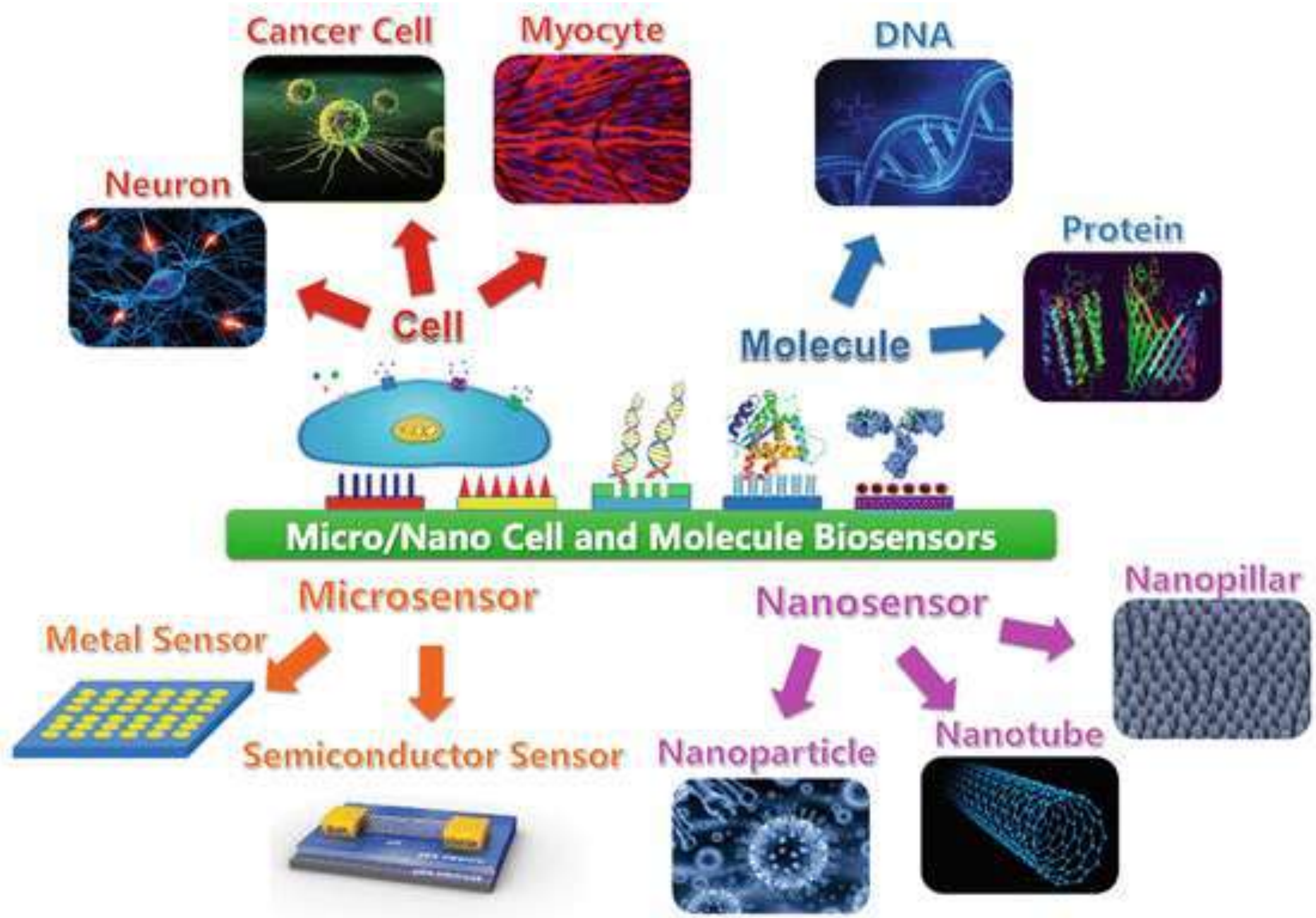
- Cell handling, which involve sorting and positioning of the cells optimally using DEP, optical traps etc.

- Field/reagent based cell lysis,where the contents of the cell are expelled out by breaking the membrane,or increase the efficiency of transfection using reagents/field.

- Intracellular processes to obtain high quality safety/toxicity ADME/T data

Biodiagnostics and (Nano) Biosensors

Biodiagnostics or biosensing is the field of sensing biological molecules based on electrochemical, biochemical, optical, luminometric methods.



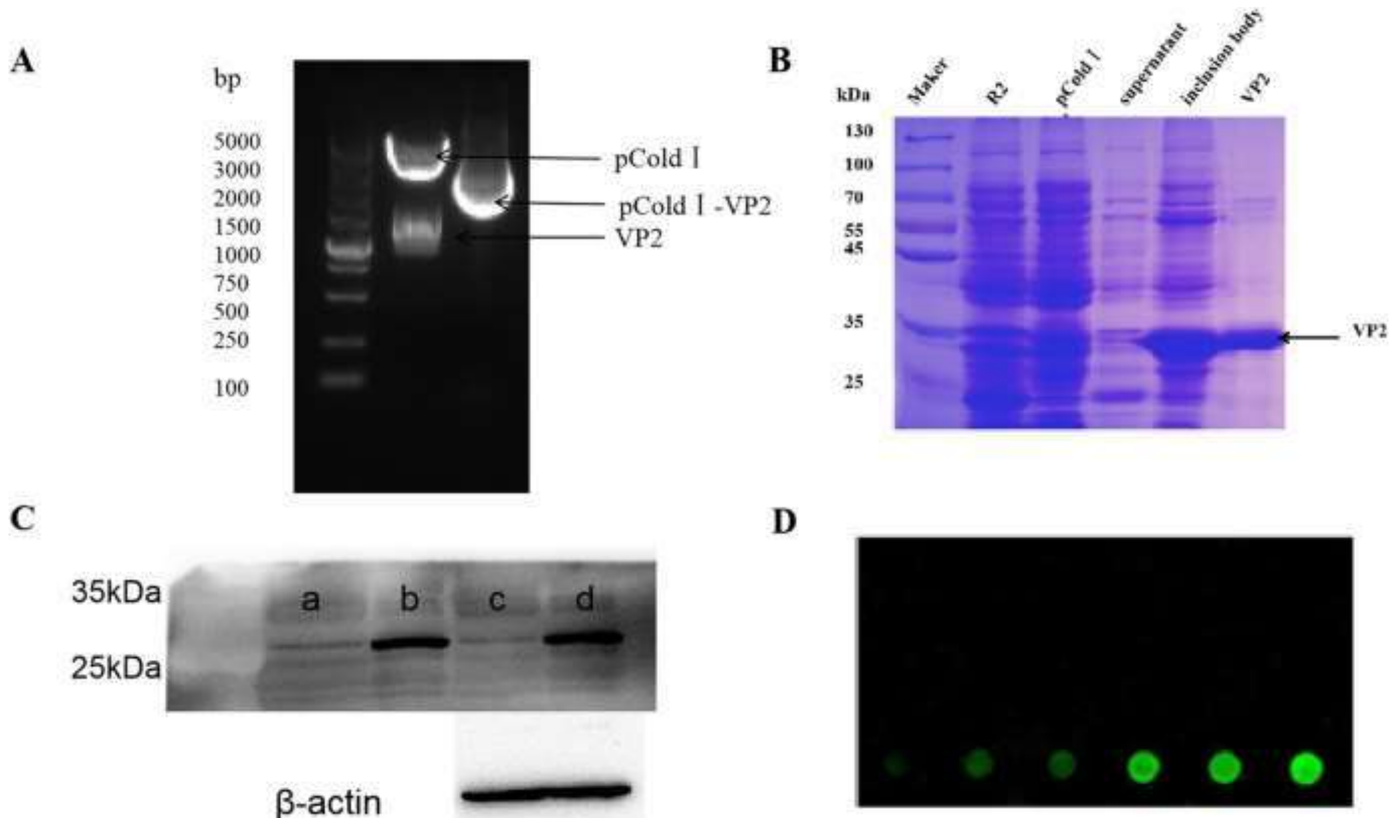
The use of Biodiagnsotics Biochip facilitate:

Genetic/Biomarker Diagnostics, development of Biowarfare sensors which involves optimization of the platform, reduction in detection time and improving the signal-to-noise ratio

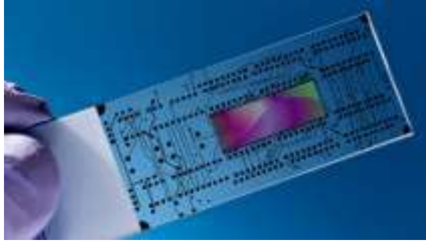
Selection of detection platform where different formats such as lateral flow vs. microfluidics are compared for ease/efficiency. Incorporation of suitable sensing modality by evaluating tradeoffs and down select detection modes(color / luminometric, electrochemical, biochemical, optical methods) for specific need.

Protein Chips for Diagnosis and Analysis of Diseases

The Protein chip is a micro-chip with its surface modified to detect various disease causing proteins simultaneously in order to help find a cure for them. Bio-chemical materials such as antibodies responding to proteins, receptors, and nucleic acids are to be fixed to separate and analyze protein.



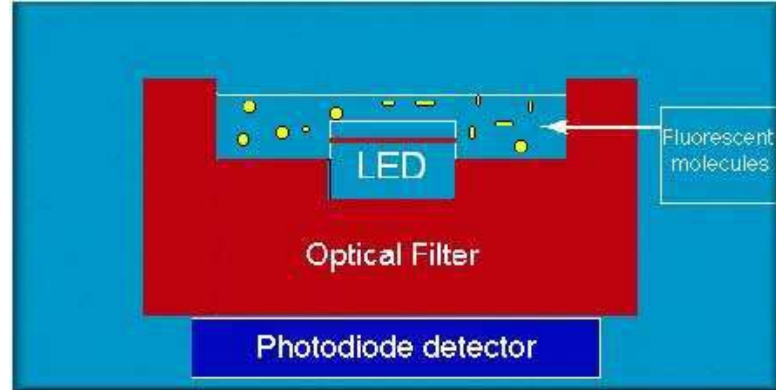
BIOCHIPS CURRENTLY UNDER DEVELOPMENT

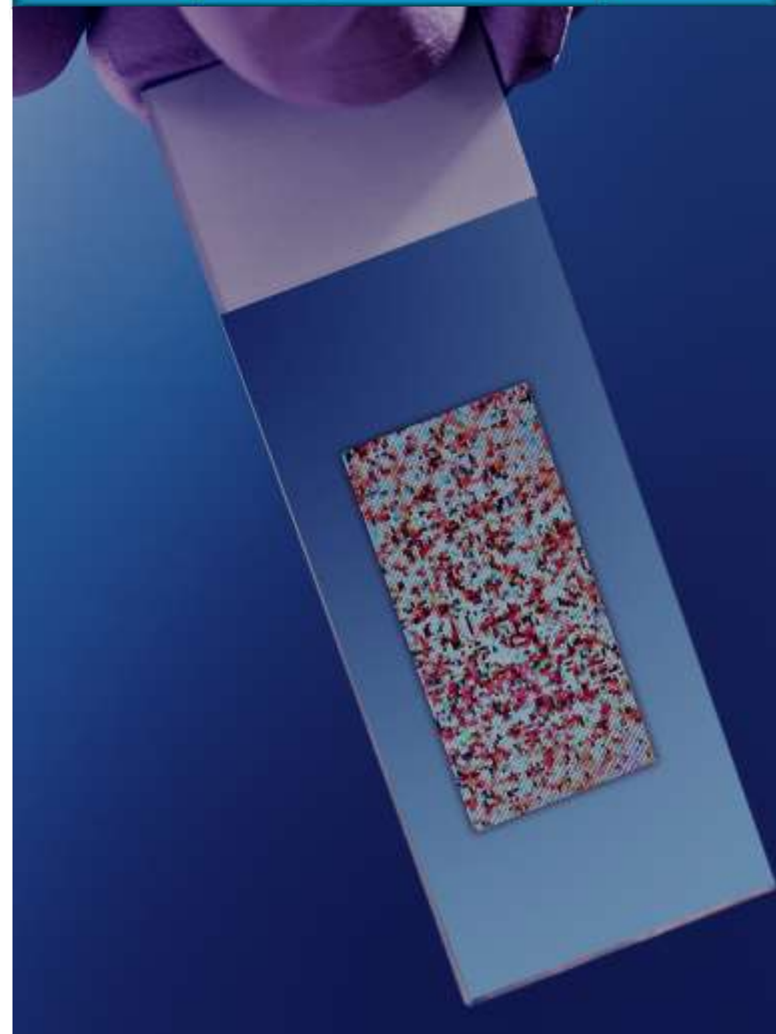


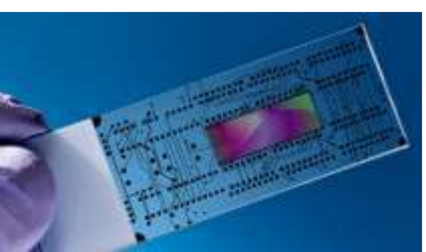
- **Glucose level detectors**
- **Oxy sensors**
- **Brain surgery with an on-off switch**
- **Adding sound to life**
- **Experiments with lost sight**

Glucose level detectors

Diabetics currently use a skin prick and a handheld blood test, and then medicate themselves with the required amount of insulin. The system is simple and works well, but the need to draw blood means that most diabetics do not test themselves as often as they should. The new S4MS chip will simply sit under the skin, sense the glucose level, and send the result back out by radio frequency communication.



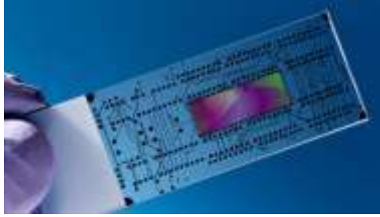


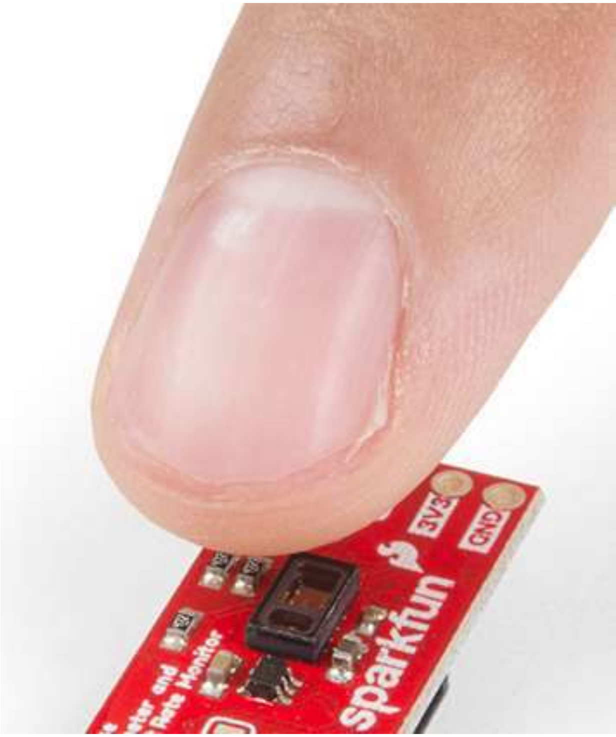


Oxy Sensors:

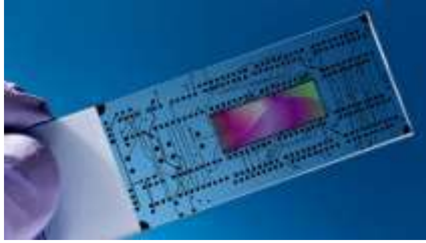
The oxygen sensors will be useful not only to monitor breathing inside intensive care units, but also to check that packages of food, or containers of semiconductors stored under nitrogen gas remain airtight.

Another version of an oxygen sensing chip currently under development sends light pulses out into the body. The light absorbed to varying extends, depending on how much oxygen is carried in the blood, and this chip detects the light that is left. The rushes of blood pumped by the heart are also detected, so the same chip is a pulse monitor. A number of companies already make large scale versions of such detectors.



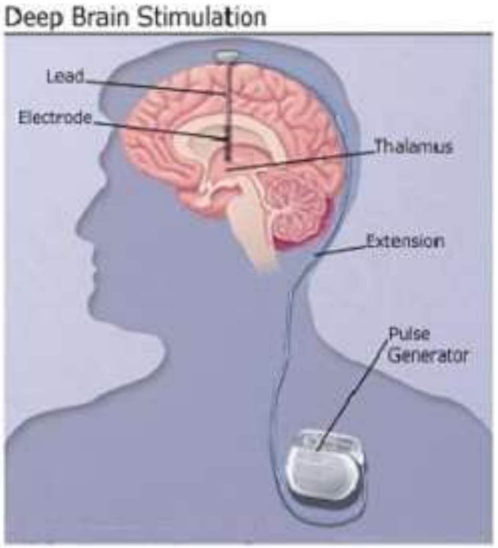


Brain surgery with an on-off switch:



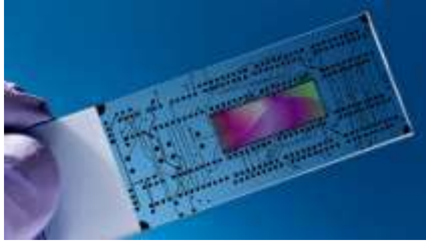
Sensing and measuring is one thing, but can we switch the body on and off? Heart pacemakers use the crude approach: large jolts of electricity to synchronize the pumping of the heart. The electric pulses of Activa implant, made by US-based Medtronics Inc., are directed not at the heart but at the brain. They turn off brain signals that cause the uncontrolled movements, or tremors, associated with disease such as Parkinson's.

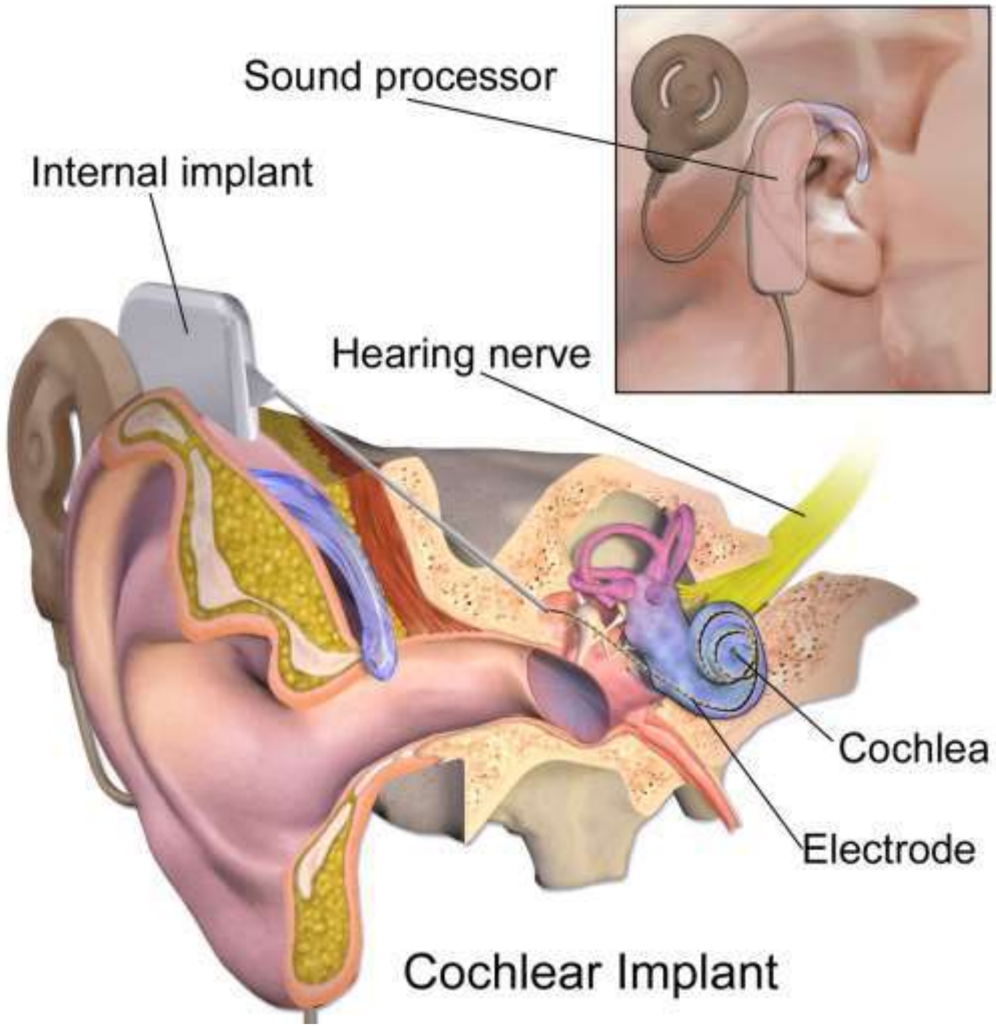
Drug therapy of Parkinson's disease aims to replace the brain messenger dopamine, a product of brain cells that are dying. But eventually the drug's effects wear off, and the erratic movements come charging back. The Activa implant is a new alternative that uses high-frequency electric pulses to reversibly shut off the thalamus.

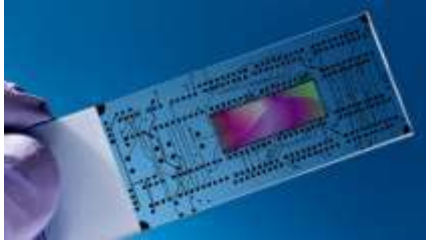


Adding sound to life

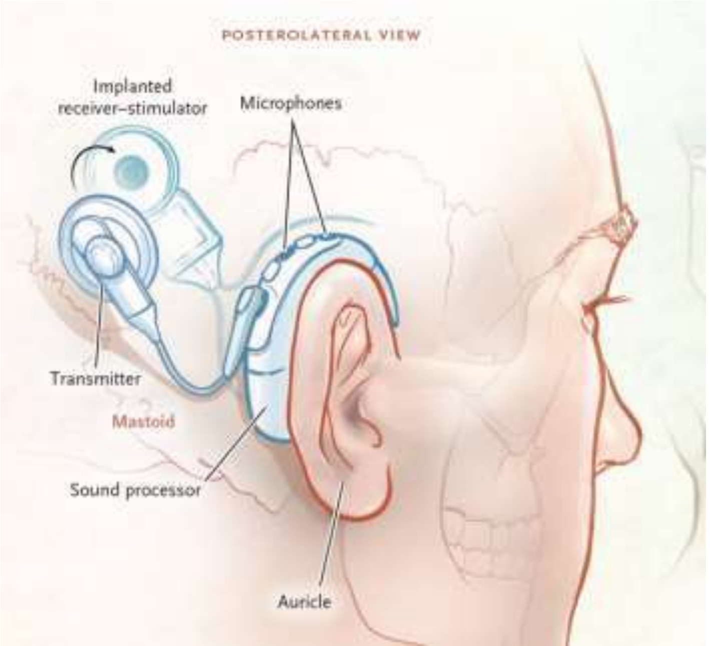
The most ambitious bioengineers are today trying to add back brain functions, restoring sight and sound where there was darkness and silence. The success story in this field is the cochlear implant. Most hearing aids are glorified amplifiers, but the cochlear implant is for patients who have lost the hair cells that detect sound waves. For these patients no amount of amplification is enough.

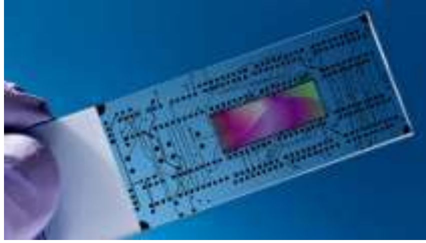






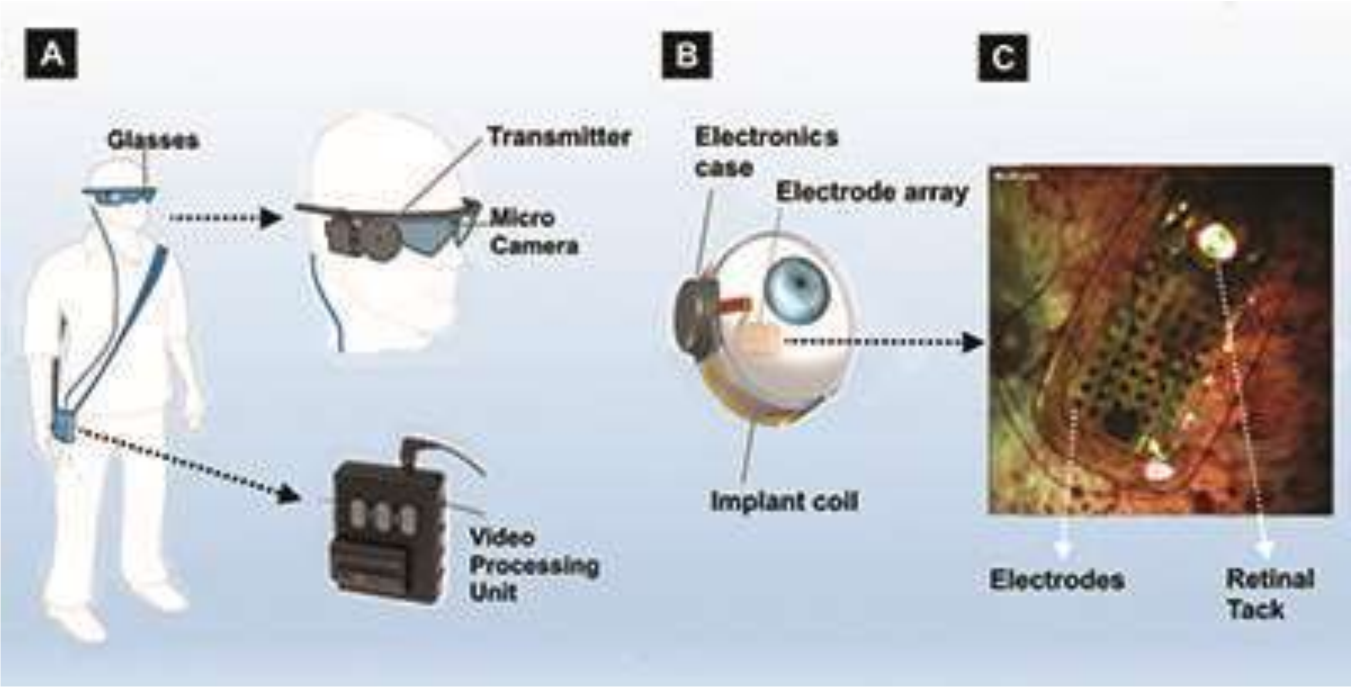
The cochlear implant delivers electrical pulses directly to the nerve cells in the cochlea, the spiral-shaped structure that translates sound in to nerve pulses. In normal hearing individuals, sound waves set up vibrations in the walls of the cochlea, and hair cells detect these vibrations. High-frequency notes vibrate nearer the base of cochlea, while low frequency notes nearer the top of the spiral. The implant mimics the job of the hair cells. It splits the incoming noises into a number of channels (typically eight) and then stimulates the appropriate part of the cochlea.

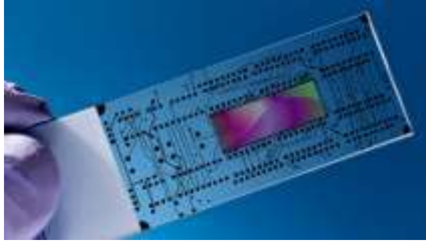




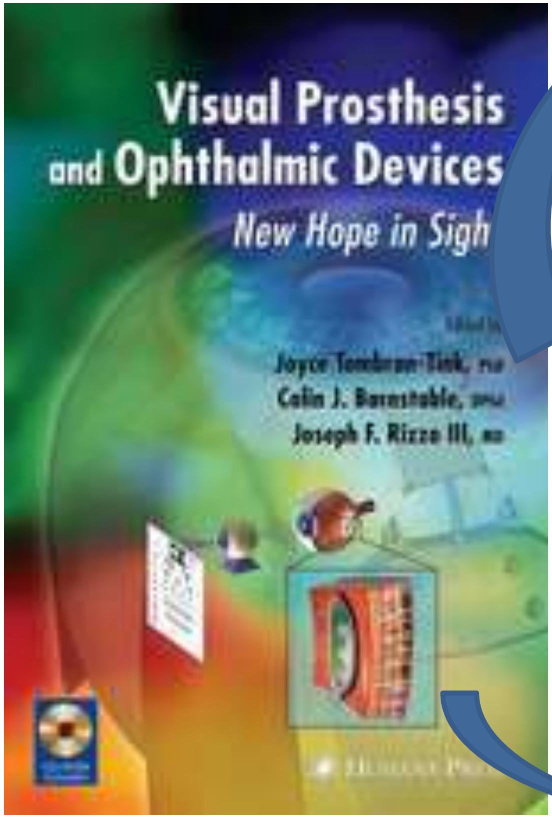
Experiments with lost sight

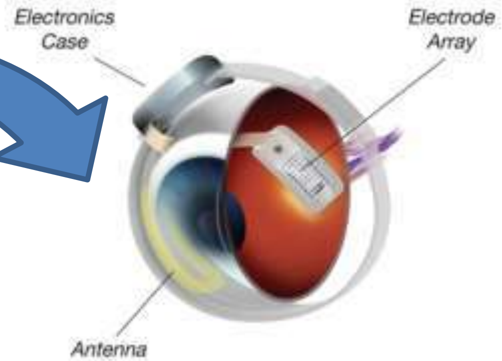
With the ear at least partially conquered, the next logical target is the eye. Several groups are working on the implantable chips that mimic the action of photoreceptors, the light-sensing cells at the back of the eye. Photoreceptors are lost in retinitis pigmentosa, a genetic disease and in age related macular degeneration, the most common reason for loss sight in the developed world.

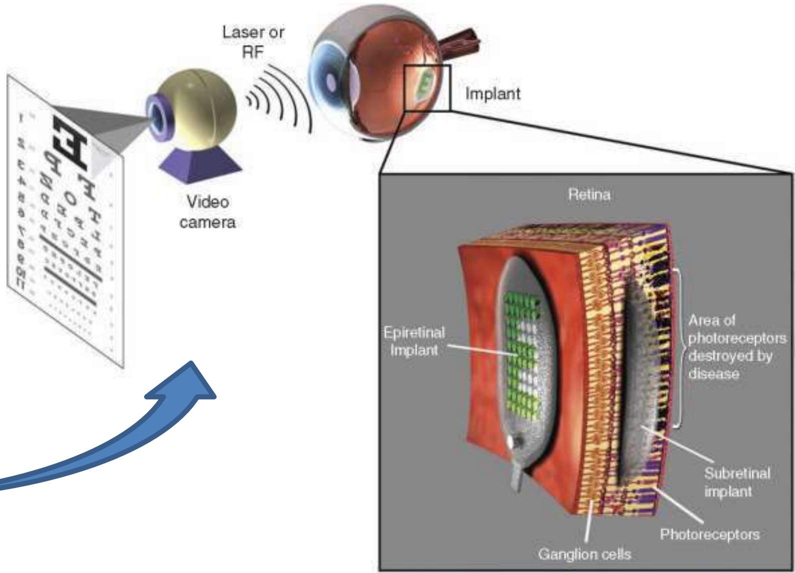




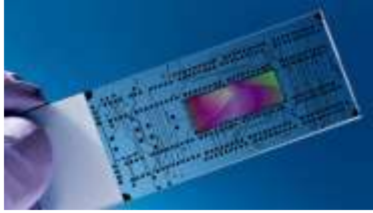
Joseph Rizzo of the Massachusetts Eye and Ear Infirmary, and **John Wyatt** of Massachusetts Institute of Technology have made a twenty electrode 1mm-square chip, and implanted it at the back of rabbit's eyes.





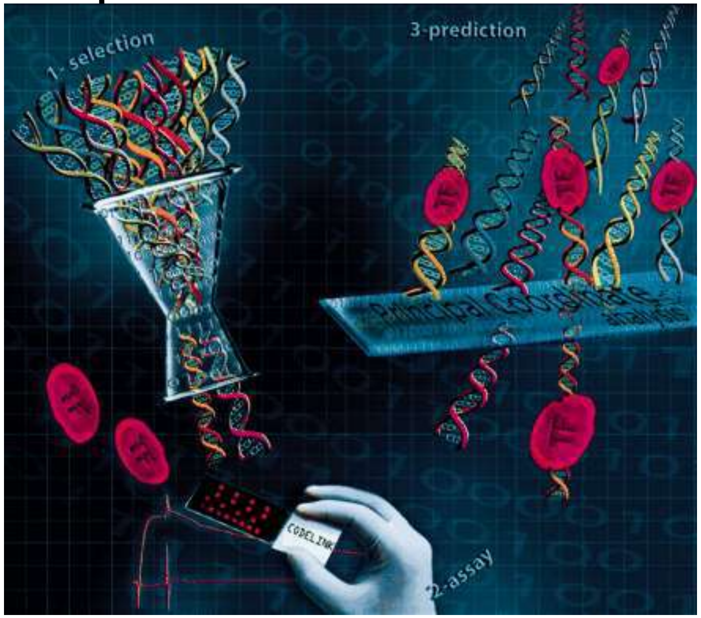


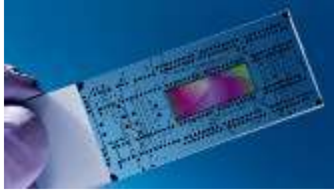
BIOCHIPS IN NONINFECTIOUS DISEASES



Biochips and Proteomics

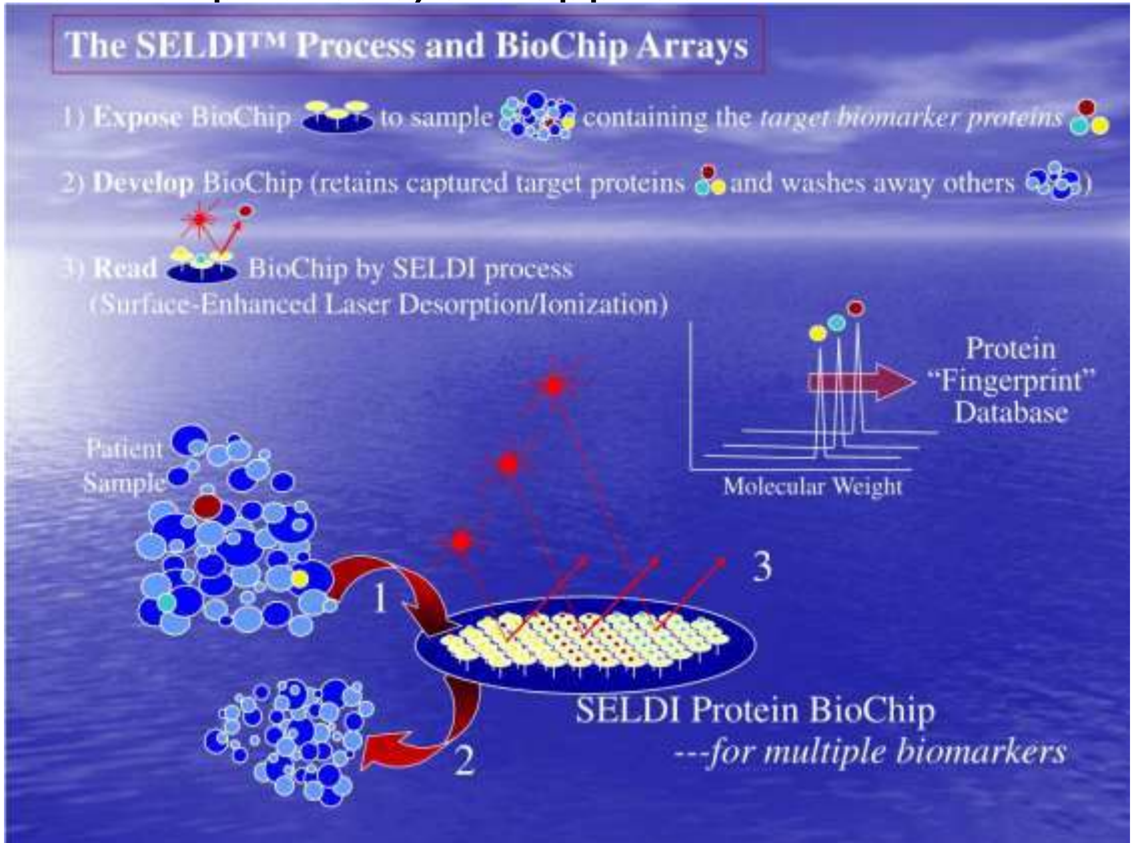
Biochip technology was largely established by the development of micro array biochips for genomics research. The emergence of the biochip was perhaps an inevitable development, an expansion of existing chemistries and concepts into the information rich world of genomics. The GeneChip, developed at Affymax, remains the best known example of a biochip.

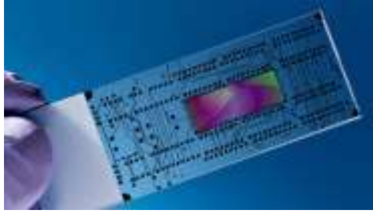




SELDI Protein Biochips

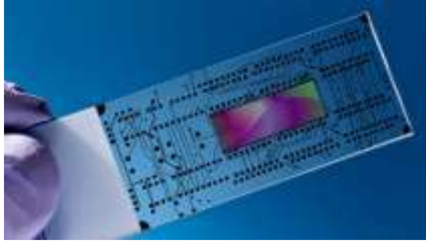
A major challenge in molecular biology, and particularly biochip development, is the detection of analytics present in mixtures at extremely low concentrations. Mixtures create limitations for the optical detection methods typically used with biochips, while low concentrations present problems when traditional separation techniques, such as 2-D electrophoresis, are applied.





Bioinformatics with SELDI Biochips

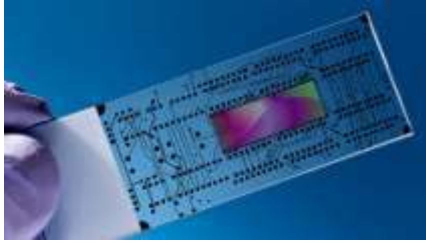
In practice, the SELDI-TOF technique provides mass spectra of proteins unmatched in both its sensitivity and its ability to identify hundreds of proteins simultaneously. A collection of protein mass spectra can be obtained from diverse biochip surfaces, using varied protein binding protocols, creating a protein map. The information in this protein map combines protein molecular weight with chemical knowledge derived from the protein binding interactions at the biochip surface.



Challenges of protein biochips

A number of challenges remain that define the current boundaries of SELDI biochip technology. For physical scientists, the optimization of surfaces that capture and present proteins is an ongoing activity, and the development of TOF MS for detection over an even wider dynamic range is essential to find rare, important proteins in the presence of ubiquitous, common proteins. For biological scientists, sequencing proteins that are discovered with SELDI-TOF MS and interpreting the complex network of revealed proteins are tasks that expand with every new sample set.

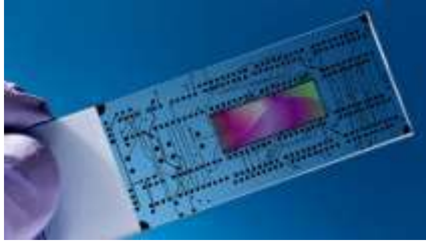
For applied mathematicians and software engineers, creating new pattern recognition tools is important as we attempt to identify weaker and weaker signals in the protein map capture.



Advantages

The ability to detect multiple viral agents in parallel e.g. differential diagnosis of agents from other diseases that cause similar clinical symptoms, or the recognition of complex mixtures of agents. .Clarification of syndromes of unknown aetiology .Increase speed of diagnosis of unknown pathogens ("future proofed" surveillance tools).

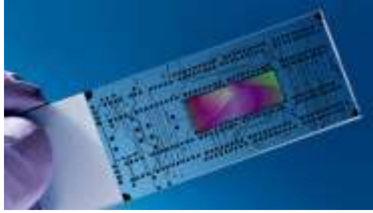
- Viral typing (AIV, FMDV, Rabies)
- Drive policy for diagnostics and disease control.
- Epidemiological tracing.
- Interagency collaboration.
- The consortium consists of National, EU and OIE reference laboratories and has access to real sample material from a wide selection of hosts and viruses.



Disadvantages

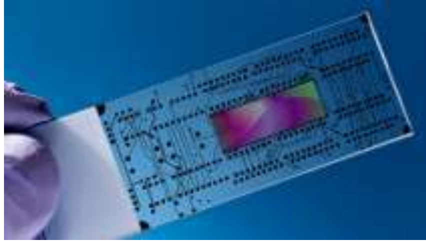
· These methods have problems that a DNA chip cannot be fabricated at high density and mass production is limited. Thus, these methods are applicable to fabrication of a DNA chip for study.

· Meanwhile, the DNA chip and the DNA microarray have different fabrication methods but are similar in that different oligonucleotides are aligned on a square spot having a certain size in a check pattern.



CONCLUSION

- Within ten years you will have a biochip implanted in your head consisting of financial status, employment and medical records.
- Even in a grocery store, sensor will read the credit chip and will automatically debit the account for purchase.
- A biochip implanted in our body can serve as a combination of credit card, passport, driver’s license and personal diary. And there is nothing to worry about losing them.
- It is said that by 2008, all members of typical American family including there pets will have microchips under their skin with ID and medical data.



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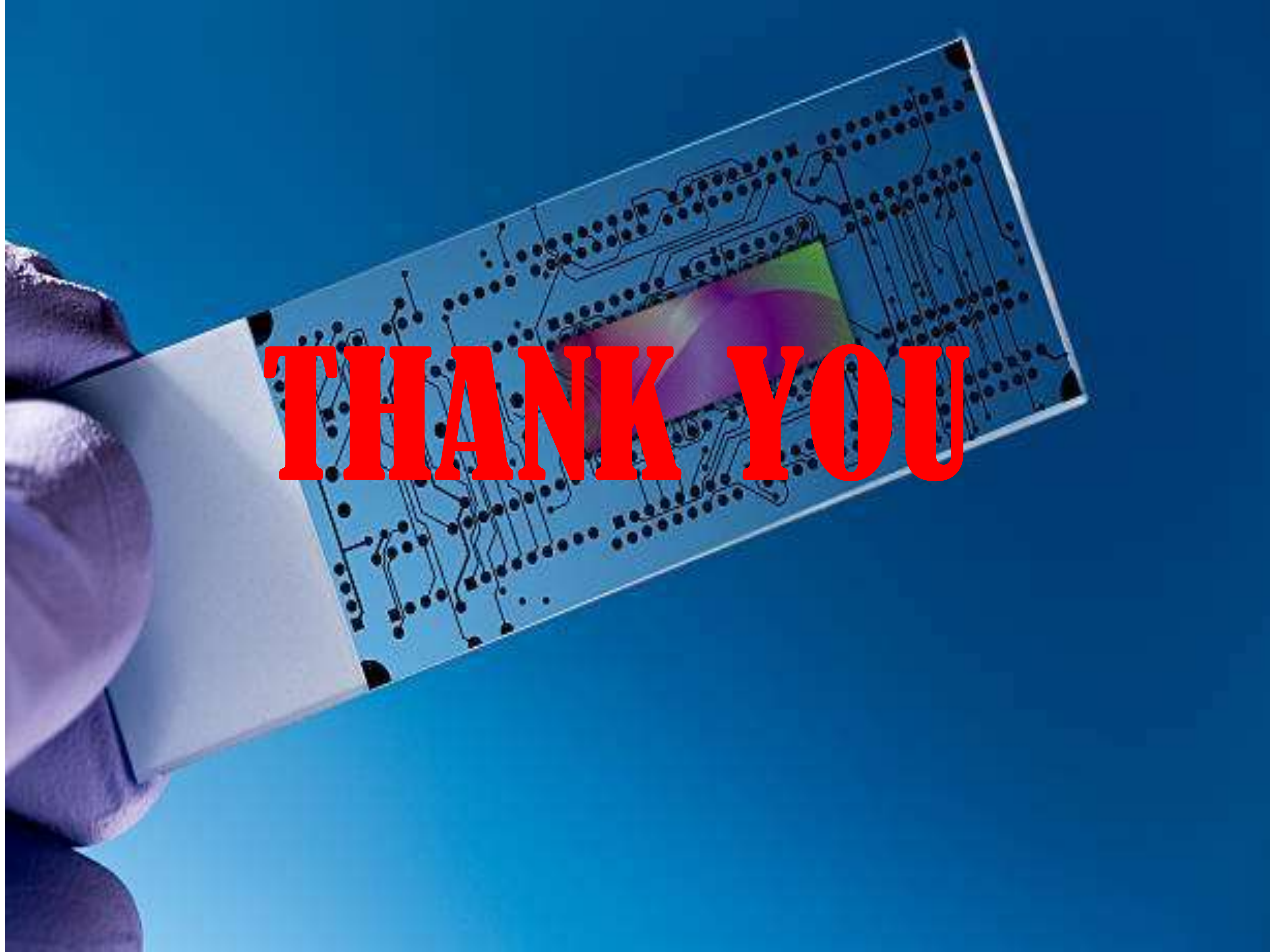
[2] R. E. Kunz, "Miniature integrated optical modules for chemical and biochemical sensing," ***Sensors and Actuators B*** 38-39, pp. 13-28, 1997.

[3]http://en.wikipedia.org/wiki/Biochip

[4]http://en.wikipedia.org/wiki/components of biochip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